

REMARKS

Claims 1 and 3-23 are pending in the application, claims 1, 22, and 23 being independent. New claims 16-23 have been added.

Claim Objections

Claim 1 has been objected to because of some informalities.

Claim 1 has been amended, as suggested by the Examiner, to overcome this objection. The Examiner is respectfully requested to reconsider and withdraw this objection.

An Embodiment of the Present Invention

An embodiment of the present invention is directed to an exhaust gas purifying apparatus of an internal combustion engine. As illustrated in FIGS. 1 and 5, the exhaust gas purifying apparatus has a light-off catalyst (L/O catalyst) 11 located in an exhaust passage 3 downstream of the internal combustion engine 1, a lean NOx catalyst (NOx catalyst) 13 located downstream of the light-off catalyst 11 in the exhaust passage 3, a three way catalyst (TWC) 14, and an electric control unit (ECU) 20 that selectively controls an air-fuel ratio of the exhaust gas between a lean air-fuel ratio and a stoichiometric air-fuel ratio or a rich air-fuel ratio.

The L/O catalyst 11 reduces HC in exhaust gas when the engine starts in a cold state, since the L/O catalyst 11 quickly reaches its activation temperature due to high-temperature exhaust gas

emitted from the engine. Further, the L/O catalyst 11 has a characteristic that it passes at least CO when the air-fuel ratio is rich (reduced oxygen concentration) such that CO is introduced into the NOx catalyst 13 to release adsorbed NOx in the NOx catalyst 13.

The NOx catalyst 13 adsorbs NOx in the exhaust gas when the air-fuel ratio is lean and releases the adsorbed NOx by the CO that has passed through the L/O catalyst 11 when oxygen concentration of the exhaust gas is reduced.

When a NOx conversion efficiency of the NOx catalyst 13 is decreased, the ECU 20 switches the air-fuel ratio from the lean air-fuel ratio to the stoichiometric or rich air-fuel ratio to introduce to the NOx catalyst 13 at least CO that has passed through the L/O catalyst 11 and maintains the air-fuel ratio at the stoichiometric or rich air-fuel ratio until the adsorbed NOx is released from the NOx catalyst 13, while maintaining the temperature of the NOx catalyst 13 below a temperature at which SOx is released. In other words, in the present embodiment, the ECU 20 recovers the NOx conversion efficiency regardless of the amount of SOx adsorbed by the NOx catalyst 13.

Thus, according to this embodiment, since the ECU 20 switches and maintains the air-fuel ratio at the stoichiometric or rich air-fuel ratio while maintaining the temperature of the NOx catalyst 13 below a temperature at which SOx is released, it is possible to

surely release the adsorbed NOx from the NOx catalyst 13 without decreasing fuel efficiency because the present embodiment does not require to modulate an amplitude of the air-fuel ratio in order to raise the temperature of the NOx catalyst 13 to the extent that it releases SOx.

Claim Rejection - 35 U.S.C. § 102

Claims 1, 5, and 8-15 have been rejected under 35 U.S.C. § 102(e) as being anticipated by *Hepburn et al.* (U.S. Patent 5,974,788). This rejection is respectfully traversed.

Hepburn discloses an apparatus for desulfating a NOx trap. More specifically, as illustrated in Fig. 1, the apparatus has a catalyst converter 26 and a NOx trap 32 located downstream of the catalyst converter 26 in an exhaust pipe 24. As disclosed at col. 1, line 45 and col. 2, lines 12-13, the catalyst converter 26 is a conventional three-way catalyst (TWC) and has an incomplete catalyst conversion characteristic. Also, as disclosed at col. 4, lines 7-12, the TWC 26 is designed such that HC, CO, and O₂ are broken through TWC 26 ^{only when TWC 26 runs out of O₂} to promote chemical reactions of HC, CO, and O₂ in the NOx trap 32, namely to create an exotherm in the NOx trap 32 and raise its temperature for releasing absorbed SOx in the NOx trap 32. Further, the apparatus operates A/F modulation (lean air-fuel ratio and stoichiometric air-fuel ratio or rich air-fuel

ratio) repeatedly to introduce HC, CO, and O₂ to the NOx trap 32 for heating.

Thus, in *Hepburn*, the apparatus modulates the amplitude of A/F to introduce HC, CO, and O₂ that has passed through TWC 26 to the NOx trap 32, and these HC, CO, and O₂ react in the NOx trap 32 to release the adsorbed SOx in the NOx trap 32 by the exotherm created by their chemical reactions.

Therefore, in *Hepburn*, if the adsorbed NOx in the NOx trap 32 is released by the above method, CO in the exhaust gas, required for releasing the adsorbed NOx, reacts with O₂, and the amount of CO introduced to the NOx trap 32 is reduced. In other words, to surely release the adsorbed NOx, the apparatus has to set the air-fuel ratio of the exhaust gas to be even richer as compared to Applicants' claimed apparatus of the present application, namely this method is undesirable in view of fuel efficiency.

Furthermore, the apparatus of *Hepburn* is for raising the temperature of the NOx trap 32 to release the adsorbed SOx. This is totally different from the claimed apparatus of present application, which maintains the temperature of the NOx catalyst during operation of ECU below a temperature at which SOx is released.

Thus, *Hepburn* does not disclose reduce "the oxygen concentration in the exhaust gas such that said CO that has passed through the light-off catalyst is introduced to said NOx catalyst

when a NOx conversion efficiency of the NOx catalyst is decreased and maintaining the reduced oxygen concentration until the adsorbed NOx in said NOx catalyst is released," as recited in claim 1. Accordingly, *Hepburn* fails disclose or even suggest the "control means" as recited in claim 1.

In view of the above, Applicants respectfully request the Examiner to reconsider and withdraw of this art grounds of rejection based on *Hepburn*.

Claim Rejections - 35 U.S.C. § 103

(a) Claims 3 and 4 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Hepburn* in view of design choice. This rejection is respectfully traversed.

Claims 3-4, variously dependent on claim 1, are allowable at least for their dependency upon claim 1.

The Examiner is respectfully requested to reconsider and withdraw this art grounds of rejection.

(b) Claims 6 and 7 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over *Hepburn* in view of design choice. This rejection is respectfully traversed.

Claims 6 and 7, variously dependent on claim 1, are allowable at least for their dependency upon claim 1.

The Examiner is respectfully requested to reconsider and withdraw this art grounds of rejection.

New Claims

New claims 16-23 have been added.

Claims 16-21, variously dependent on claim 1, are allowable at least for their dependency upon claim 1.

Independent claim 22 is allowable since none of the prior art of record discloses or even suggests "switching an air-fuel ratio of the exhaust gas from an lean air-fuel ratio to a stoichiometric air-fuel ratio or a rich air-fuel ratio while maintaining temperature of said NOx catalyst under a temperature in which SOx is released," as recited therein.

Independent claim 23 is allowable since none of the prior art of record discloses or even suggests "repeatedly releasing NOx adsorbed by the NOx catalyst every first interval and repeatedly releasing SOx adsorbed by the NOx catalyst every second interval longer than the first interval," as recited therein.

A favorable determination and allowance of claims 16-23 is earnestly solicited.

Conclusion

Accordingly, in view of the above amendments and remarks, reconsideration of the rejections and objections, and allowance of the pending claims are earnestly solicited.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully

requested to contact Maki Hatsumi (Reg. No. 40,417) at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

Pursuant to 37 C.F.R. §§ 1.17 and 1.136(a), Applicant(s) respectfully petition(s) for a one (1) month extension of time for filing a reply in connection with the present application, and the required fee of \$110.00 is attached hereto.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

By  (Reg. # 40,417)
for Terrell C. Birch, #19,382

TCB:MH/mh:pjh
1472-0177P

P.O. Box 747
Falls Church, VA 22040-0747
(703) 205-8000